NDT Methods Technical Reference Guide

Selection Matrix, Capabilities & Engineering Limitations for Conventional & Advanced NDT

CATEGORY: TECHNICAL GUIDE | POSITIONING: INSPECTION PRECISION. ASSET INTEGRITY. OPERATIONAL CONFIDENCE.

1. Principle of Method Selection

No single nondestructive testing method detects every discontinuity type across all geometries and materials. Method selection requires evaluating material metallurgy, component thickness, surface accessibility, expected flaw orientation, applicable acceptance code, and whether volumetric or surface data is required.

2. Conventional & Advanced NDT Comparison

Method	Primary Detection Target	Key Operational Considerations &
Ultrasonic Testing (UT)	Internal volumetric/planar discontinuities & wall thickness	Requires couplant, surface preparation, and acoustic accessibility; sensitivity depends on beam angle.
Magnetic Particle (MT)	Surface & slight subsurface linear flaws	Restricted strictly to ferromagnetic materials; requires clean surface and sufficient magnetization.
Liquid Penetrant (PT)	Surface-breaking open discontinuities	Non-porous materials only; cannot detect subsurface flaws; surface contamination masks indications.
Radiographic Testing (RT)	Internal volumetric flaws & corrosion profiles	Requires controlled radiation exclusion zones, dual-side access, and strict statutory radiation safety.
Visual Testing (VT)	Surface geometry, weld profile, corrosion, fit-up	Surface-only examination; illumination, line-of-sight access, and surface cleanliness are critical.
Phased Array UT (PAUT)	Complex weld geometries, crack sizing & encoded mapping	Higher setup calibration rigor; requires trained Level II/III PAUT personnel and scan-plan validation.
Time of Flight Diffraction (TOFD)	Accurate through-wall defect height sizing in welds	Lateral-wave and back-wall dead zones typically require complementary UT/PAUT or surface NDT.
Long Range UT (LRUT)	Axial screening of long/buried/insulated pipe runs	Screening tool only; indications require follow-up local sizing via UT/PAUT or visual verification.

Internal Rotary Inspection (IRIS)	Internal/external wall loss & pitting in heat exchanger tubes	Requires thorough tube cleaning and water flooding; slower throughput than electromagnetic screening.

3. Scope Definition Checklist for Engineers

- Specify base metal grade, nominal wall thickness, outer diameter, and joint/weld configuration.
- Identify applicable construction or in-service code (e.g., ASME Sec V / VIII, API 1104, AWS D1.1, ISO 17640).
- Confirm surface temperature, coating thickness, insulation status, and scaffolding/rope access needs.
- Define required deliverable format (encoded digital A/B/C-scan files, thickness grids, or summary sheets).